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tively long time. Cultures were made of *Asplenium* and *Onoclea Struthiopteris* in 1884, from spores sown August 31. They grew rapidly and soon developed quantities of antheridia, but in the case of *Asplenium, no archegonia.* As cold weather came on, although the prothallia were kept in the house, growth ceased almost entirely, but was resumed in the spring, the prothallia appearing perfectly healthy. Large numbers then developed archegonia, and subsequently young plants, but some of them are still (August 14) perfectly vigorous, and growing.

The older male prothallia assume very irregular forms, reminding one somewhat of the prothallia of *Equiseta*, but the female retain nearly the same form as they have when young although they may be slightly irregular.

The sexual organs continue to form as the prothallia grow, so that in the older ones the number is very large. A female prothallium of Asplenium, about one cm. in diameter, examined August 12, had over one hundred and twenty-five archegonia, but no antheridia. One of the archegonia had been recently fertilized, but the remainder were abortive. It sometimes happens that several archegonia will be impregnated, but only one embryo apparently ever develops perfectly.

In the older prothallia of *Onoclea Struthiopteris*, especially early in the spring, large quantities of starch were observed.

Explanation of Plate IX.—Figs. 1-5, successive stages in germination of the spore of *Onoclea sensibilis.* × 150. Fig. 6, an older prothallium of the same, showing the apical cell (a), and marginal papillæ (p). × 80. Fig. 7, very small male prothallia of *Asplenium filix-fœmina* antheridia (a). × 150. Figs. 8-9, large male prothallia of the same. × 150. Fig. 10, a male prothallium, about three months old, of *Onoclea Struthiopteris.* × 60. Fig. 11, mature prothallium of *Cystopteris fragilis.* × 5.

On the Appearance of the Relation of Ovary and Perianth in the Development of Dicotyledons.[1]

BY JOHN M. COULTER.

Two years ago I read before this section a paper upon the "Development of the Dandelion," an organogenic study, in which it incidentally appeared that the first character to show itself was that of the inferior ovary. Since then this hint has been somewhat extensively followed up, and the results form the reason for the present paper.

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[1] Read before the American Association for the Advancement of Science, August, 1885.

It is well enough known that botanical classification is in a transition state, that the published systems of classification are even far behind our knowledge, and that our knowledge is very far from what it ought to be. Sooner or later everything artificial must be abandoned and the natural substituted for it. It is a matter of great congratulation among botanists that Bentham & Hooker were permitted to finish their magnificent "Genera Plantarum," but it is also to be regretted that they have rendered still more rigid certain groupings which should plainly have been abandoned.

It is very far from the object of this paper to suggest a new scheme of classification, for an appalling array of facts must first be accumulated, but simply to record some observations which seem to have their bearing upon the solution of this difficult problem.

One of our greatest grievances has been the persistent displacement of Gymnosperms, whose true position both their floral organs and paleontology have long since pointed out, but this paper is chiefly concerned with the group Dicotyledons. Here the artificial grouping into Polypetalæ, Gamopetalæ, and Apetalæ has become threadbare and worn from long use, and in the present state of our knowledge it is worse than useless to attempt to patch it up. Although confessedly artificial it distorts relationships in too plain a way and draws down upon us the criticism of the most superficial. The group Apetalæ, intercalating most intricately with Polypetalæ, is yet separated from them by Gamopetalæ, which are much more highly developed than either.

As embryology has been of such invaluable aid in Zoölogical classification, it is but reasonable to suppose that organogeny may be able to play some such part in botany.

Upon the discovery that the inferior ovary was the first character to appear in the development of the dandelion flower, I began a somewhat extensive examination of the larger dicotyledonous families, to discover how the character was sustained. The fact was recognized that the dicotyledonous character was first to appear in the plant life, and hence it seemed that development shows no more natural grouping of Angiosperms than into Dicotyledons and Monocotyledons.

About one hundred and fifty species were examined, from the very earliest stages of the flower to its full development, belonging to the following eleven orders: Ranunculaceæ, Leguminosæ

Rosaceæ, Saxifragaceæ, Onagraceæ, Rubiaceæ, Umbelliferæ, Compositæ, Borraginaceæ, Scrophulariaceæ, and Labiatæ. The result was that in every case the first recognizable character was that of inferior or superior ovary, and a most simple grouping on that basis was apparent.

The appearance of this character in development can be told in a few words. In the case of an inferior ovary, the protuberance which is to develop into the flower is arrested in its axial development, grows peripherally into a collar, and soon there appears an external constriction, distinguishing the nascent floral envelopes above from the ovary below. The character of an external constriction is always the most readily recognized, and is as sure a mark of an inferior ovary as the harder seen arrest of axial development.

In the case of a superior ovary, the axial development is continued, and there is no external constriction. All this is perfectly clear before there is a possible recognition of any other floral character.

It may be instructive to look at a few of the results of such a basis of classification. Naturally, if organogeny means anything, the plants with inferior ovaries must be regarded as more highly and more recently developed than those whose flower parts are hypogynous. Hence Compositæ, Umbelliferæ, Rubiaceæ, Onagraceæ, and their various appendages would stand together as of highest rank, the first named order for some time having been considered the most highly developed. The resemblances between Compositæ and Umbelliferæ other than that of an inferior ovary are very suggestive.

In all natural classification there is a limbo of intermediate forms whose relationships are not so hard to discover as to arrange, and the cases of ovaries neither decidedly superior nor inferior are very familiar to every botanist. In such an intermediate place would stand the orders Rosaceæ and Saxifragaceæ, whose mutual boundary wall has already broken down.

In the group with superior ovaries there would appear such orders as Leguminosæ, Scrophulariaceæ, Labiatæ, etc., great groups with irregular flowers, and probably representing the highest development of dicotyledons with superior ovaries. Following these, and intergrading with them, appears the polymorphous order Ranunculaceæ, and so on.

In the terms of our present classification, such a grouping would result somewhat as follows:

Ovary inferior.	Some Gamopetalæ and Polypetalæ, such as Compositæ Umbelliferæ, Rubiaceæ, Onagraceæ, etc.
Ovary superior.	Some Gamopetalæ and Polypetalæ, such as Leguminosæ, Scrophulariaceæ, Labiatæ, etc., and Apetalæ.

It must be distinctly understood that the above does not present a proposed classification, but simply traces some of the probable results of organogenic study.

It is of no small consequence in these days to obtain the testimony of paleontology in favor of any system of classification. The order of appearance of Phanerogams is well known; first, Gymnosperms, then Monocotyledons, long afterward Dicotyledons, and the last Dicotyledons were those with inferior ovaries. From such great composite groups as Compositæ, therefore, the flora of the future is to be worked out.

GENERAL NOTES.

Results of the Ann Arbor Meeting.—This meeting gave more than the usual opportunities for becoming acquainted and benefited by the society of the members during the intervals between the regular sessions, owing to the short radius within which the members found entertainment, and the fewer distractions than in the case of large meetings, with their multiplicity of excursions and receptions. This advantage was made good use of by most, and it is safe to say that, so far as the botanists are concerned, no former meeting has yielded such full and satisfactory returns in this regard.

The attendance of botanists was unexpectedly large, and gives assurance of the continued prosperity of the club.

The efforts of the club from the beginning have been directed toward raising the standard of the botanical papers presented to the Association, and it is gratifying to note that this is actually being accomplished. It is certain that as a whole the botanical papers of this year will compare more favorably with those presented in other departments of biology than at any previous time. This is both because the papers are actually better than usual, and because the less weighty ones have been sifted out. These siftings found appropriate presentation before the club, where they met a sympathetic audience ready to turn to good use every morsel of value they contained. The total result is that the Association gets better botanical papers, and the botanists get through the club more items, notes and news than heretofore.

The committee of the Association on the encouragement of researches on the health and diseases of plants reported that the first and very important object in view had been accomplished. This was the recognition from the Commissioner of Agriculture of the need of work of this kind and some provision for its prosecution at Washington. Commissioner Colman, upon receiving the